(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 510 871 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : 92303398.9

(22) Date of filing : 15.04.92

(51) Int. Cl.[5] : **G11B 27/32**, G11B 23/04, G11B 23/30

(30) Priority : **23.04.91 JP 92004/91**

(43) Date of publication of application : **28.10.92 Bulletin 92/44**

(84) Designated Contracting States : **DE FR GB**

(71) Applicant : **MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.**
1006, Oaza Kadoma
Kadoma-shi, Osaka-fu, 571 (JP)

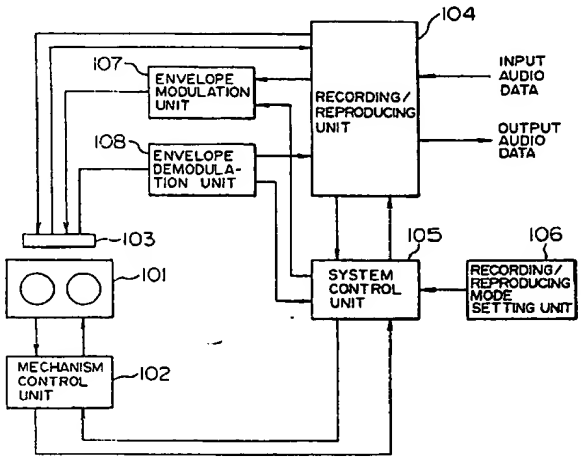
(72) Inventor : **Adachi, Tatsuya**
30-1-309, Miiminamimachi
Neyagawa-shi (JP)

(74) Representative : **Sorrell, Terence Gordon et al**
Fitzpatricks Europe House World Trade Center
London E1 9AA (GB)

(54) Toc recording/reproducing device.

(57) A TOC recording/reproducing device which can shorten the time taken to read TOC by searching a nearer TOC, on the basis of tape position information detected from a tape in reproduction, of the same TOCs recorded at both starting terminals on first and second recording surfaces of the tape.

FIG. 1



EP 0 510 871 A2

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a TOC recording/reproducing device provided with a recording medium having two kinds of directions, such as S - DAT (Stationary-head Digital Audio Tape Recorder).

Description of the Related Art

In recent years, digital technology has been applied to a large number of technical fields such as acoustics and image processing, and techniques relative to a CD player, a R - DAT (Rotary-head Digital Audio Tape Recorder), a digital VTR, etc. has been build. Among them, the technique of pursuing comfort for use such as high speed search as well as the basic technique of recording/reproducing PCM signals has become important.

Among the high speed search techniques, attention has been paid to the method named 'TOC' (Table of Contents) in which the head of a desired musical piece is searched and reproduced using a table of base (head) addresses of musical pieces.

The conventional search method using TOC is disclosed in e.g. "JAS Journal" published by Nippon Audio Association, November, 1987, pp. 26-27.

An explanation will be given of the conventional high speed search method.

Fig. 10 shows a record of the tape for realizing the conventional high speed search. A TOC recording area named 'U -TOC' a user can record is located at the starting end of the tape. The U - TOC area is succeeded by audio data which are divided into units called programs. Usually, one musical piece corresponds to one program. Each program is numbered by the corresponding 'program number'. The absolute times indicative of the absolute addresses on the tape are recorded on the tape.

The format of the absolute time and TOC in DAT is described in "DIGITAL AUDIO TAPERECORDER SYSTEM" published by DAT Conference, June 1987, pp. 72-77.

An explanation will be given of the method of searching a program number using TOC.

When a cassette is inserted into a reproducing device, the U - TOC area at the tape starting terminal is searched to read TOC to be stored. Thereafter, if a direction of searching a program number is issued, the absolute time indicative of the head of the directed program is read from the stored TOC, thereby searching the position on the tape on which the absolute time has been recorded. Since the absolute times have been continuously recorded on the tape, if a user carries out the high speed search while reading the absolute time to compute the difference between the current position and a target position and earlier decelerate the speed, he can realize the optimum speed control. Thus, the time taken for the program search can be shortened. However, the conventional TOC recording/reproducing device, in which the TOC data is recorded only at the starting terminal of a tape, takes a relatively long time to read TOC first.

SUMMARY OF THE INVENTION

The present invention intends to solve the above disadvantage of the conventional high speed search method.

An object of the present invention is to provide a TOC recording/reproducing device which can shorten the time taken to read TOC by searching a nearer TOC, in TOC searching, of two TOCs recorded at both starting terminals on two recording surfaces of a tape.

In order to attain the above object, the TOC recording/reproducing device according to the present invention comprises starting terminal searching means for searching the starting terminal on a first surface of a tape having two recording surfaces, first TOC recording means for recording a first TOC at the starting terminal on the first surface, record starting point searching means for searching the starting terminal or record starting point on the second surface, and second TOC recording means for recording a second TOC having the same content as that of the first TOC at the starting terminal or record starting point on the second surface of the tape.

Further, the TOC reproducing device according to the present invention comprises tape position detecting means for detecting a position on a tape to output tape position information, tape length detecting means for detecting a tape length to output tape length information, TOC searching means for searching, on the basis of the tape position information and the tape length information, either of TOCs at the starting terminal on the first surface and the starting terminal or record starting point on the second surface, and TOC reproducing means for reproducing the searched TOC.

The above arrangement of the present invention can shorten the time taken for TOC searching in program number searching by detecting a current position on a tape to search a nearer TOC of the same TOCs recorded

at the starting terminal on the first side of the tape and the starting terminal or record starting point on the second side thereof. Also in updating the TOC data, the above arrangement can shorten the time taken for TOC searching in rewrite by rewriting the nearer TOC earlier.

The above and other object and features of the present invention will be more apparent from the following description taken with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. I is a block diagram of an arrangement of the TOC recording/reproducing device according to an embodiment of the present invention;

Fig. 2 is a pattern view of the a recording track pattern recorded on a tape by a recording head in the embodiment of Fig. I;

Fig. 3 is a schematic view of an exemplary record of a auxiliary data on the tape in the embodiment of Fig. I;

Fig. 4 is a format view of a recording format of the supplemental data;

Fig. 5 is a flowchart of the operation in the system control unit I05 in recording TOC in the embodiment of Fig. I;

Fig. 6 is a schematic view of the recording state of the auxiliary data on the tape after the TOC recording processing has been made in the embodiment of Fig. I;

Fig. 7 is a flowchart of the operation in the system control unit I05 in reproducing TOC to do program searching in the embodiment of Fig. I;

Fig. 8 is a schematic view of a record on the tape when a sixth program is added to the record shown in Fig. I;

Fig. 9 is a flowchart view of the operation in the system control unit I05 in updating TOC to do program searching in the embodiment of Fig. 8; and

Fig. I0 is a view for explaining a record on a tape for realizing the conventional searching method.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Now referring to the drawings, an explanation will be given of one embodiment of the present invention.

Fig. I is a block diagram of the recording/reproducing device including a TOC recording/reproducing device according to one embodiment of the present invention.

In Fig. I, numeral I0I denotes a cassette for housing a magnetic tape, and numeral I02 denotes a mechanism control unit for controlling the running of the magnetic tape in accordance with an instruction from a system control unit I05. The mechanism control unit I02 checks the rotation of a reel to send a tape end terminal flag to the system control unit I05 when the tape reaches its end terminal. The mechanism control unit I02 detects opening or closing of two identification holes of the cassette to send tape length information to the system control unit I05.

Table I shows a relationship between the state of two identification (ID) holes and a tape length.

Table 1

ID hole 1	Id hole 2	tape length
closed	closed	45 minutes
closed	open	60 minutes
open	closed	90 minutes
open	open	120 minutes

Further, the mechanism control unit I02 detects the rotation of the reel to detect whether the tape has reached its starting terminal or its end terminal, thereby sending tape terminal information to the system control unit I05.

Numeral I03 denotes a recording/reproducing unit for doing the recording or reproducing for the magnetic

tape. The recording head is composed of 9 (nine) heads; one of them serves to record a supplemental data such as a control data for reproduction control whereas the remaining 8 (eight) heads serve to record a main data such as an audio data. The reproducing head is also composed of 9 (nine) heads; one of them serves to produce a supplemental channel reproduction signal including the control data for reproduction control whereas the remaining 8 (eight) heads serve to produce a main channel reproduction signal including the audio data. The magnetic tape is divided into two upper and lower areas; one is used for forward recording whereas the other is used for reverse recording. The area, which is used for forward recording, is called "side A" whereas the other is called "side B". In order to change the running direction of the tape, the head 103 is rotated by 180°.

Fig. 2 shows a recording track pattern on the tape recorded on the recording head.

Again referring to Fig. 1, a recording/reproducing unit 104 adds an error correction code to an input audio data and 8-10 modulates it to supply the resultant signal to the eight recording heads for main-channel recording as a main channel record signal. The recording/reproducing unit 104 adds an error correction code to the supplemental data used for running control supplied from the system control unit 105 and modulates it to supply the resultant signal to an envelope modulating unit 107 as a auxiliary channel record data. The recording/reproducing unit 104 demodulates the reproduction signal reproduced from the eight heads for main-channel reproduction in the recording/reproducing head 103, error-corrects the demodulated signal and produce the resultant signal as an output audio data. The recording/reproducing unit 104 demodulates the supplemental channel reproduction data reproduced from the one head for auxiliary-channel reproduction in the recording/reproducing head 103, error-corrects the demodulated signal and produce the resultant signal as a supplemental data. The recording/reproducing unit 104 also supplies these data to the system control unit 105. The supplemental data recorded by the recording/reproducing unit 104 includes a TOC which is a table of absolute times representative of absolute positions on the tape and absolute times of the heads of programs.

Incidentally, the record signal produced by the recording/reproducing unit 104 is sectioned into 200 msec units of frames; the minimum unit of record is one frame.

The system control unit 105 gives the running mode to the mechanism control unit 102 and gives the recording mode and the reproducing mode to the recording/reproducing unit 104. The system control unit 105 sends out data used for search control such as absolute times and TOC to provide the search mark information such as a start ID flag, a read-out area ID flag, etc. to the envelope modulation unit 107. The system control unit 105 receives the run-length information of the auxiliary data demodulated from the envelope demodulation unit 108 to detect the search mark information. It should be noted that the system control unit 105 can be realized by a microprocessor. Numeral 106 denotes a recording/reproducing mode setting unit through which a user gives a command to the system control unit 105. Namely, using the recording/reproducing mode setting unit 106, the user gives the system control unit 105 an schematic instruction of the operation mode such as recording, reproducing or searching.

In this embodiment, the input/output data for the recording/reproducing device was the audio data, but it may be the other data such as a video data; these data are generally called main data in contrast to the auxiliary data used for control. The envelope modulation unit 107 modulates the auxiliary channel record data outputted from the recording/reproducing unit 104 on the basis of the search mark information such as the starting ID flag, the read-out ID flag, etc. and supplies the modulated data to the one recording head for auxiliary-channel recording in the recording/reproducing head 103.

An explanation will be given of the operation of recording TOC by the recording/reproducing device according to this embodiment thus constructed.

Fig. 3 shows a record of auxiliary data on a tape.

As seen from Fig. 3, side A has three program numbers of 1 to 3 recorded thereon whereas side B has two program numbers of 4 to 5 recorded thereon. An absolute time A - TIME is recorded continuously from the starting point of program 1 on side A to the ending point of program 5 on side B. The absolute time at the ending point D of program 3 on side A has the same value as that at the starting point E of program 4 on side B.

Recorded at the record ending point of side A is a reverse marker RMK which indicates that the record starting point on side B is present successively to the record ending point on side A. Also recorded at the record starting point of side B is another reverse mark RMK.

Fig. 4 shows an exemplary record format of auxiliary data.

The auxiliary data are recorded by 8 - 10 modulation.

As seen from Fig. 4, bytes 0 to 2 represent the absolute time data in a current frame. The most significant bit S of byte 0 is an identification flag of side A/B for the current frame; S = 0 represents side A whereas S = 1 represents surface B. The higher three bits of bits 4 to 6 in byte 0 denote a BCD (binary-coded decimal) code representative of a hour digit of the absolute time of the current frame. The lower four bits of bits 0 to 3 in byte 0 denote a BCD code representative of a frame number digit(s) of the absolute time of the current frame. Byte 1 denotes a BCD code representative of a minute digit(s) of the absolute time of the current frame. Byte 2 denotes

a BCD code representative of a second digit(s) of the absolute time of the current frame.

It should be noted that the time of one frame is 200 msec and hence five frames of 0 to 4 corresponds to one minute.

Bytes 3 to 6 are TOC data I. Specifically, byte 3 denotes a BCD code (program number data I) representative of the program number of a program expressed by TOC data I. Bytes 4 to 6 denote the absolute time of the head or starting frame of the program expressed by the program data number data I. The most significant bit S of byte 4 is an identification flag of side A/B for the current frame; S = 0 represents side A whereas S = I represents side B. The higher three bits of bits 4 to 6 in byte 4 denote a BCD (binary-coded decimal) code representative of a hour digit of the absolute time of the current frame. The lower four bits of bits 0 to 3 in byte 4 denote a BCD code representative of a frame number digit(s) of the absolute time of the current frame. Byte 5 denotes a BCD code representative of a minute digit(s) of the absolute time of the current frame. Byte 6 denotes a BCD code representative of a second digit(s) of the absolute time of the current frame.

It should be noted that a program denotes one musical piece and a program number denotes the number of the musical piece. It should be also noted that an absolute time denotes a time code representative of the absolute position on a tape, and hence increases monotonously from the starting terminal of a certain side.

Bytes 7 to I0 are TOC data 2. Specifically, byte 7 denotes a BCD code (program number data 2) representative of the program number of a program expressed by TOC data 2. Bytes 8 to I0 denote the absolute time of the head or starting frame of the program expressed by the program data number data I. The most significant bit S of byte 8 is an identification flag of side A/B for the current frame; S = 0 represents side A whereas S = I represents side B. The higher three bits of bits 4 to 6 in byte 8 denote a BCD (binary-coded decimal) code representative of a hour digit of the absolute time of the current frame. The lower four bits of bits 0 to 3 in byte 8 denote a BCD code representative of a frame number digit(s) of the absolute time of the current frame. Byte 9 denotes a BCD code representative of a minute digit(s) of the absolute time of the current frame. Byte I0 denotes a BCD code representative of a second digit(s) of the absolute time of the current frame.

It should be noted that TOC data I and TOC data 2 are different TOC data. In order to improve the transfer rate of the TOC data, two kinds of TOC data are recorded in one frame.

The most significant bit of byte II represents a reverse marker.

Fig. 5 shows in flowchart the operation of the system control unit I05 (Fig. I) in recording TOC. As seen from Fig. 5, in step 50I, an instruction of search mode is issued to the mechanism control unit I02 and the recording/reproducing unit I04 to search the head of each of all programs so that the program number and the absolute time of the head of the program denoted by that program number are read and stored in the memory in the system control unit I05. In step 502, using the stored program numbers and the absolute times at the heads of the corresponding programs, TOC data are made.

In step 503, the starting point of side A is searched. Then, the system control unit I05 directs the mechanism control unit to rewind a reel and decides if or not the tape has reached its terminal on the basis of a tape terminal flag sent out from the mechanism control unit I02. The mechanism control unit I02 detects the tape terminal in such a manner that an FG (frequency generator) monitors the rotation state of the reel to send out the tape terminal flag when the reel stops.

In step 504, the system control unit I05 gives an instruction of recording mode to the mechanism control unit I02 and also sends the TOC data to the recording/reproducing unit I04 to record TOC. In step 505, the starting terminal or record starting point of surface B is searched. Then, if the system control unit I05 detects of either condition of the tape terminal flag supplied from the mechanism control unit I02 and the reverse marker of the reproduced auxiliary data supplied from the recording/reproducing unit I04, it directs the mechanism control unit I02 to stop the running of the tape. In step 506, the system control unit I05 gives an instruction of recording mode to the mechanism control unit I02 and also sends the TOC data to the recording/reproducing unit I04 to record TOC.

Fig. 6 shows the recording state of the auxiliary data on the tape after the above TOC recording processing has been executed. As seen from Fig. 6, the TOCs having the same contents are recorded at the starting terminal of side A and that of side B, respectively.

An explanation will be given of the operation of the system control unit I05 where the recording/reproducing device according to this embodiment carries out program searching using TOC.

Fig. 7 shows in flowchart the operation of the system control unit I05 when TOC is reproduced to search a program.

Now it is assumed that the tape has a record as shown in Fig. 6.

In step 70I, the system control unit I05 receives a target program number from the recording/reproducing mode setting unit I06.

In step 702, the system control unit I05 gives an instruction of reproducing mode to the mechanism control unit I02 and the recording/reproducing unit I04 to accept the absolute time TC in the auxiliary data from the

recording/reproducing unit. Through this step, the system control unit 105 can know the position of the tape now being reproduced.

In step 703, it reads the tape length ID sent from the mechanism control unit 102 to know a tape length TL.

In step 704, where the absolute time of side A is read, if it is smaller than 1/2 of the tape length TL, the processing branches into step 705 whereas it is larger than 1/2 of the tape length TL, the processing branches into step 706. Where the absolute time of side B is read, if it is larger than 3/2 of the tape length, the processing branches into step 705 whereas if it is smaller than 3/2 of the tape length, the processing branches into step 706. In short, in step 704, it is decided that the current position is nearer to which of the starting position of side A and that of side B.

In step 705, the system control unit 105 directs the mechanism control unit 102 and the recording/reproducing unit 104 to search TOC at the starting terminal of side A. Then, the system control unit 105, if it detects the tape terminal information supplied from the mechanism control unit 102, directs the mechanism control unit 102 to stop the running of the tape.

In step 706, the system control unit 105 directs the mechanism control unit 102 and the recording/reproducing unit 104 to search TOC at the starting terminal of surface B. Then, if the system control unit 105 detects of either condition of the tape terminal information supplied from the mechanism control unit 102 and the reverse marker of the reproduced supplemental data supplied from the recording/reproducing unit 104, it directs the mechanism control unit 102 to stop the running of the tape.

In step 707, the system control unit 105 gives an instruction of reproducing mode to the mechanism control unit 102 and the recording/reproducing unit 104, and receives the TOC data from the recording/reproducing unit 104 to extract the absolute time of the head of a target program. In step 708, the system control unit 105 gives an instruction of search mode to the mechanism control unit 102 and the recording/reproducing unit 104. In step 709, after the head of the target program is searched in step 708, an audio data is reproduced.

An explanation will be given of the operation of the system control unit 105 where the recording/reproducing device according to this embodiment updates TOC.

Fig. 8 is a record of the tape when the six-th program (program 6) is added to the record shown in Fig. 6. In this case, the programs on the tape differ from those registered on TOC, which requires updating of TOC.

Fig. 9 shows in flowchart the operation of the system control unit 105 when TOC is updated.

In step 901, the system control unit 105 receives a target program number from the recording/reproducing mode setting unit 106.

In step 902, the system control unit 105 gives an instruction of reproducing mode to the mechanism control unit 102 and the recording/reproducing unit 104 to read the absolute time TC in the auxiliary data from the recording/reproducing unit 104. Through this step, the system control unit 105 can know the position of the tape now being reproduced.

In step 903, it reads the tape length ID sent from the mechanism control unit 102 to know a tape length TL.

In step 904, where the absolute time of side A is read, if it is smaller than 1/2 of the tape length TL, the processing branches into step 905 whereas it is larger than 1/2 of the tape length TL, the processing branches into step 912. Where the absolute time of side B is read, if it is larger than 3/2 of the tape length, the processing branches into step 905 whereas if it is smaller than 3/2 of the tape length, the processing branches into step 912. In short, in step 904, it is decided that the current position is nearer to which of the starting position of side A and that of side B.

In step 905, the system control unit 105 directs the mechanism control unit 102 and the recording/reproducing unit 104 to search TOC at the starting terminal of side A. Then, the system control unit 105, if it detects the tape terminal information supplied from the mechanism control unit 102, directs the mechanism control unit 102 to stop the running of the tape. In step 912, the system control unit 105 directs the mechanism control unit 102 and the recording/reproducing unit 104 to search TOC at the starting terminal of side B. Then, if the system control unit 105 detects of either condition of the tape terminal information supplied from the mechanism control unit 102 and the reverse marker of the reproduced supplemental data supplied from the recording/reproducing unit 104, it directs the mechanism control unit 102 to stop the running of the tape. In step 907, the system control unit 105 gives an instruction of reproducing mode to the mechanism control unit 102 and the recording/reproducing unit 104, and receives the TOC data from the recording/reproducing unit 104 to be stored in the memory in the system control unit 105. In step 908, the system control unit 105 changes the TOC data corresponding to the added or canceled program. For example, where the record shown in Fig. 6 has been changed to that shown in Fig. 8, the data of the program 6 is read to be added to TOC. In step 909, the system control unit 105 gives an instruction of recording mode to the mechanism control unit 102 and the recording/reproducing unit 104 to record TOC on side A. In step 910, the system control unit 105 directs the mechanism control unit 102 and the recording/reproducing unit to search TOC at the starting terminal of side B. In step 911, the system control unit 105 gives an instruction of recording mode to the mechanism control unit 102 and the recording/reproducing unit

104 to record on side B the same TOC as recorded on side A.

As described above, in step 912, the system control unit 105 directs the mechanism control unit 102 and the recording/reproducing unit 104 to search TOC at the starting terminal of side B. In step 913, the system control unit 105 gives an instruction of reproducing mode to the mechanism control unit 102 and the recording/reproducing unit 104, and receives the TOC data from the recording/reproducing unit 104 to be stored in the memory in the system control unit 105. In step 914, the system control unit 105 changes the TOC data corresponding to the added or canceled program. For example, where the record of Fig. 6 has been changed into that of Fig. 8, the data of the program is added to the read TOC. In step 915, the system control unit 105 gives an instruction of recording mode to the mechanism control unit 102 and the recording/reproducing unit 104 to record the changed TOC on side B. In step 916, the system control unit 105 directs the mechanism control unit 102 and the recording/reproducing unit 104 to search TOC at the starting terminal on side A. In step 917, the system control unit 105 gives an instruction of recording mode to the mechanism control unit 102 and the recording/reproducing unit 104 to record on side A the same TOC as recorded on side B.

In accordance with this embodiment, since the same TOCs are recorded at the record starting terminals on side A of the tape and side B thereof, respectively, in program searching using TOC, the time taken for TOC searching can be shortened by reading the nearer TOC of both TOCs. Also in adding or canceling a program, the time taken for TOC rewriting can be shortened by rewriting the nearer TOC of both TOCs earlier.

As understood from the above explanation, the TOC recording/reproducing device according to the present invention can shorten the time taken for TOC searching in program number searching by detecting a current position on a tape to search a nearer TOC of the same TOCs recorded at the starting terminal on surface A of a tape and the starting terminal or record starting point on surface B thereof. Also in updating the TOC data, the above device can shorten the time taken for TOC searching in rewrite by rewriting the nearer TOC earlier.

Claims

1. A TOC recording device (Fig. 5) comprises:
   starting terminal searching means (503) for searching the starting terminal on a first side of a tape having two recording side;
   first TOC recording means (504) for recording a first TOC at the starting terminal on the first side;
   record starting point searching means (505) for searching the starting terminal or record starting point on the second side; and
   second TOC\recording means (506) for recording a second TOC having the same content as that of the first TOC at the starting terminal or record starting point on the second side of the tape.

2. A TOC recording/reproducing device (Fig. 9) comprising:
   tape position detecting means (902) for detecting a position on a tape to output tape position information;
   tape length detecting means (903) for detecting a tape length to output tape length information;
   first TOC searching means (905, 912) for searching, on the basis of said tape position information and said tape length information, a first TOC at either the starting terminal on the first side or the starting terminal or record starting point on the second side;
   TOC reproducing means (907, 913)) for reproducing said searched first TOC;
   TOC creating means (908, 914) for creating a new TOC data on the basis of said reproduced first TOC;
   first TOC recording means (909, 915) for recording a third TOC on said reproduced first TOC on the basis of said new TOC data;
   second TOC searching means (910, 916) for searching a second TOC on the side on which said third TOC is not still recorded; and
   second TOC recording means (911, 917) for recording again a fourth TOC having the same content as that of said third TOC on said searched second TOC.

3. A TOC reproducing device (Fig. 7) comprising:
   tape position detecting means (702) for detecting a position on a tape to output tape position information;
   tape length detecting means (703) for detecting a tape length to output tape length information;
   TOC searching means (705. 706) for searching, on the basis of said tape position information and said tape length information, either of TOCs at the starting terminal on the first side and the starting terminal

or record starting point on the second side; and

TOC reproducing means (707) for reproducing said searched TOC.

4. A TOC recording/reproducing device according to claim 2, wherein said tape length detecting means comprises identification code reading means for reading an identification code recorded on a cassette.

5. A TOC reproducing device according to claim 3, wherein said tape length detecting means comprises identification code reading means for reading an identification code recorded on a cassette.

6. A TOC recording/reproducing device according to claim 2, wherein said TOC searching means comprises terminal detecting means for detecting the starting terminal or ending terminal of the tape.

7. A TOC reproducing device according to claim 3, wherein said TOC searching means comprises terminal detecting means for detecting the starting terminal or ending terminal of the tape.

FIG. 1

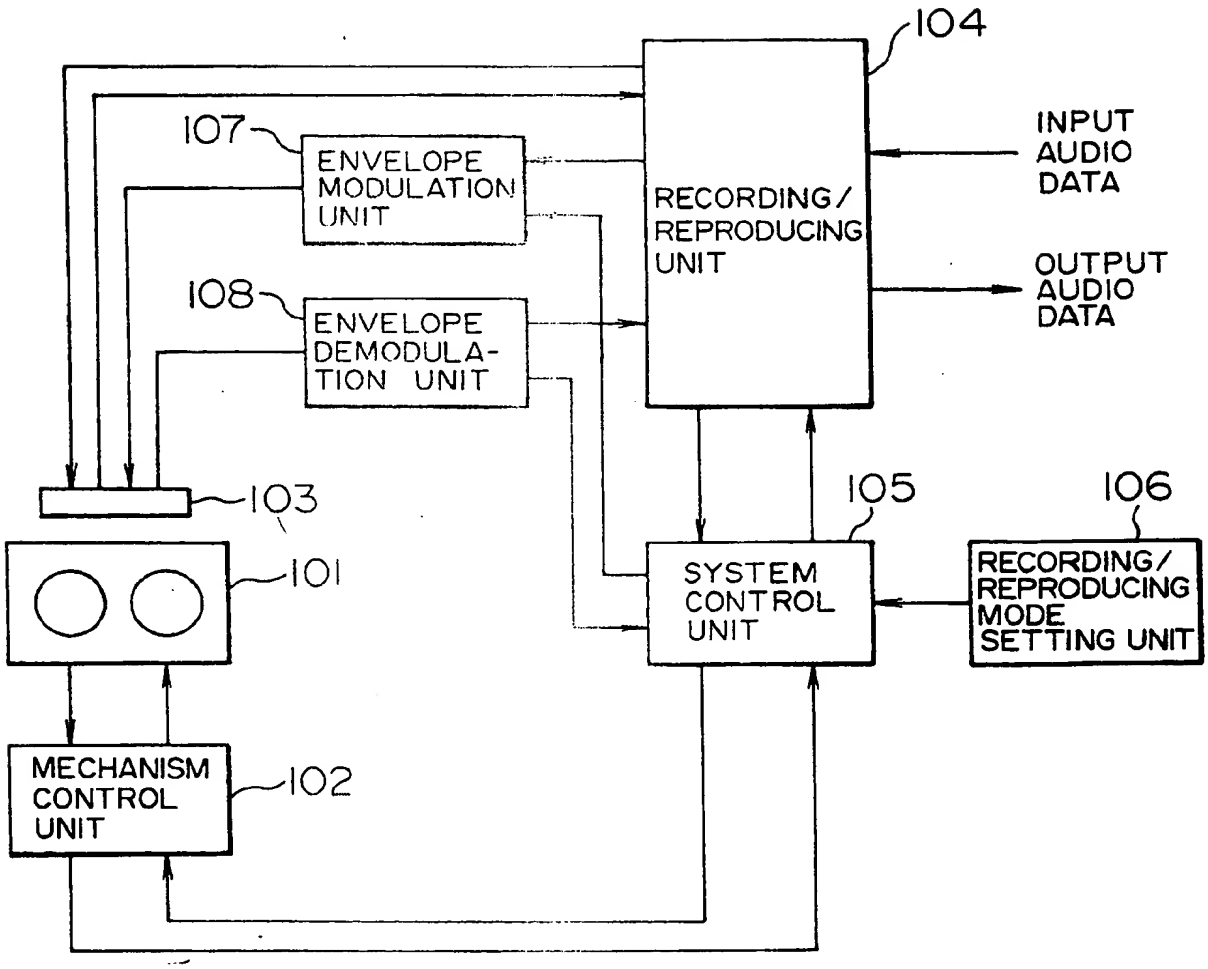

104
107
ENVELOPE MODULATION UNIT
INPUT AUDIO DATA
RECORDING/ REPRODUCING UNIT
OUTPUT AUDIO DATA
108
ENVELOPE DEMODULATION UNIT
103
105
106
101
SYSTEM CONTROL UNIT
RECORDING/ REPRODUCING MODE SETTING UNIT
MECHANISM CONTROL UNIT
102

FIG. 2

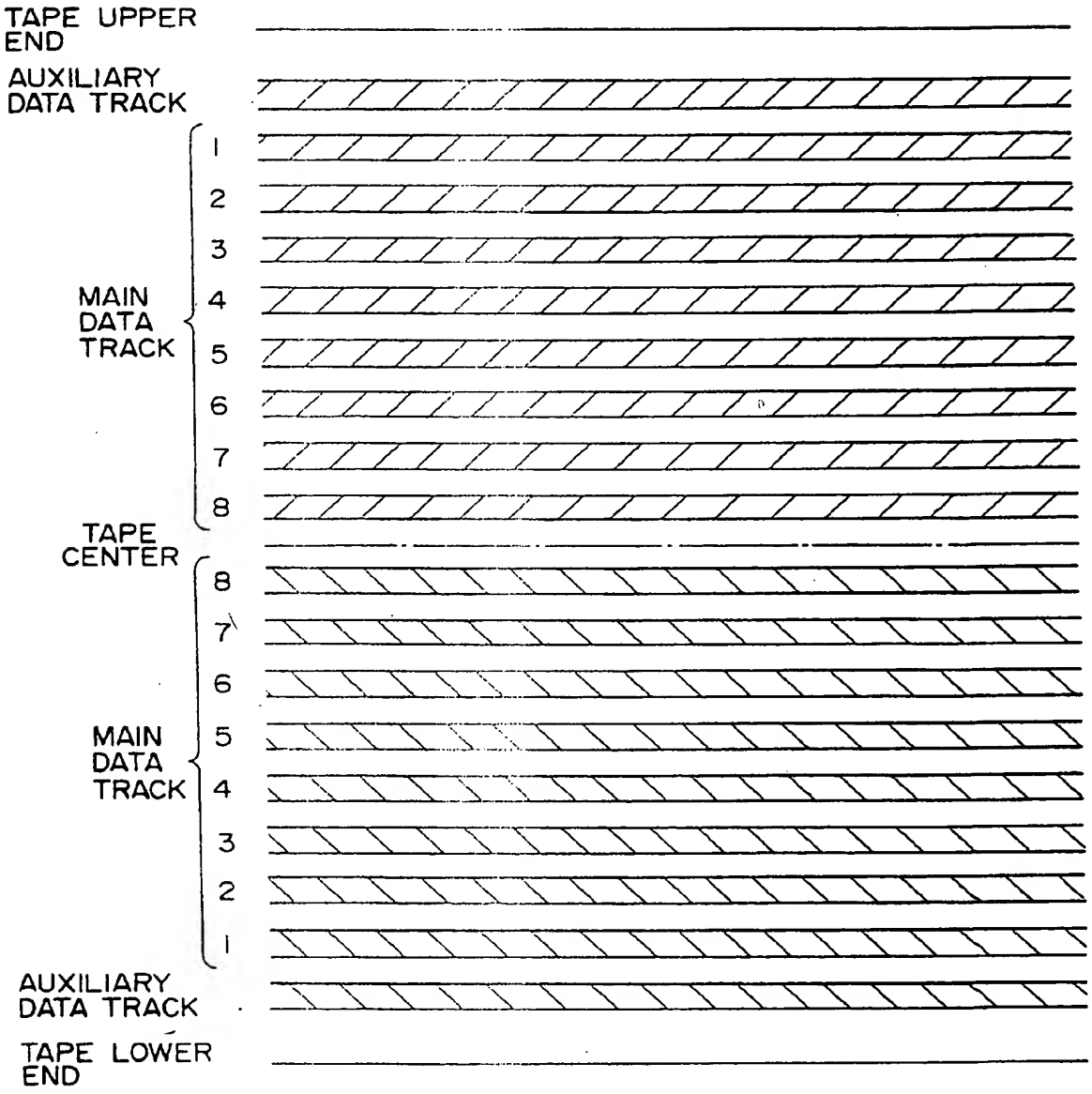

TAPE UPPER END
AUXILIARY DATA TRACK
MAIN DATA TRACK
1
2
3
4
5
6
7
8
TAPE CENTER
8
7
6
MAIN DATA TRACK
5
4
3
2
1
AUXILIARY DATA TRACK
TAPE LOWER END

FIG. 3

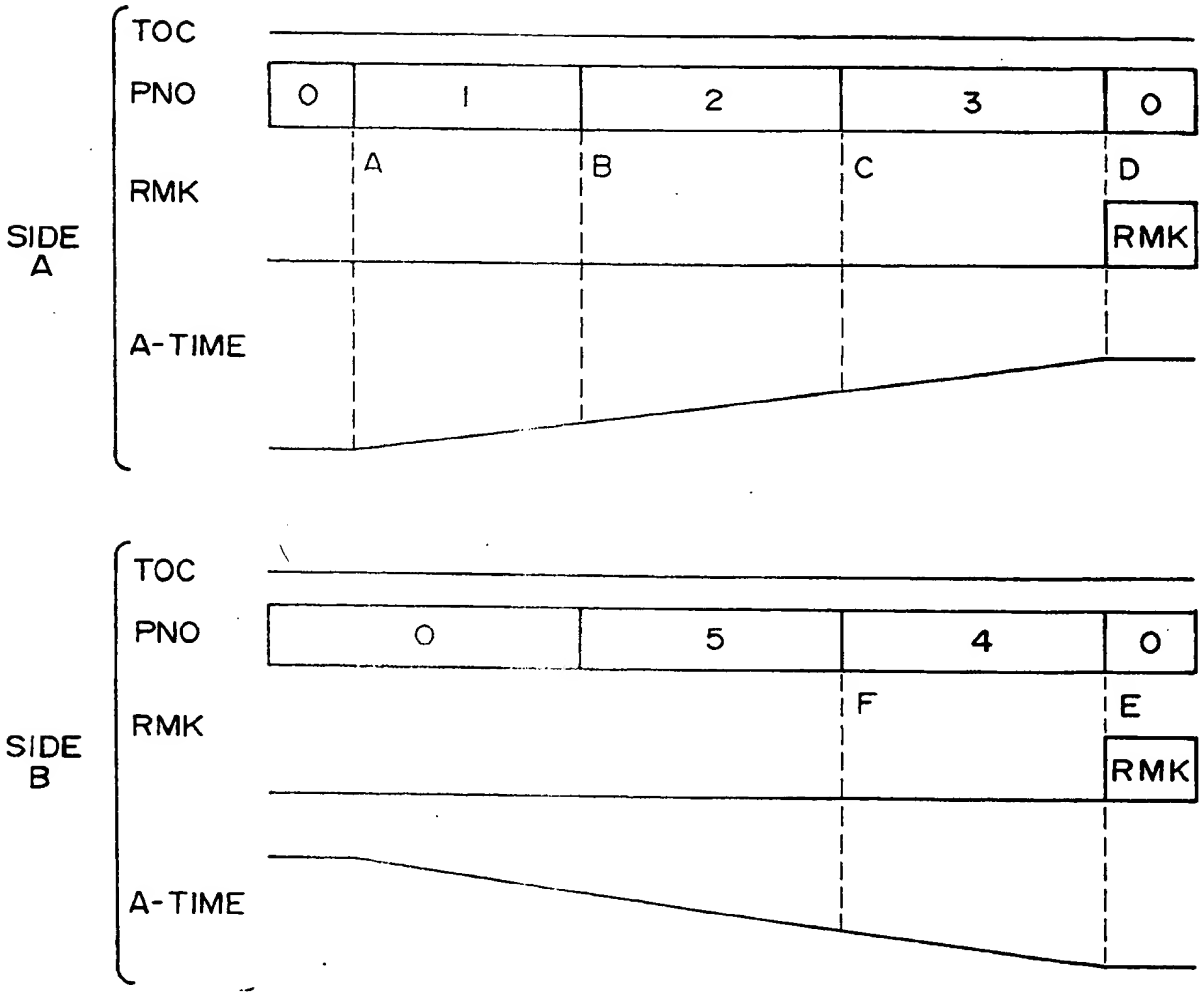

SIDE A
TOC
PNO
0
1
2
3
0
RMK
A
B
C
D
RMK
A-TIME
SIDE B
TOC
PNO
0
5
4
0
RMK
F
E
RMK
A-TIME

FIG. 4

BIT NUMBER / BYTE NUMBER	7	6	5	4	3	2	1	0
0	S	CURRENT HOUR DATA			CURRENT FRAME NUMBER DATA			
1	CURRENT MINUTE DATA							
2	CURRENT SECOND DATA							
3	PROGRAM NUMBER DATA 1							
4	S	HOUR DATA 1			FRAME NUMBER DATA 1			
5	MINUTE DATA 1							
6	SECOND DATA 1							
7	PROGRAM NUMBER DATA 2							
8	S	HOUR DATA 2			FRAME NUMBER DATA 2			
9	MINUTE DATA 2							
10	SECOND DATA 2							
11	RMK							

FIG. 5

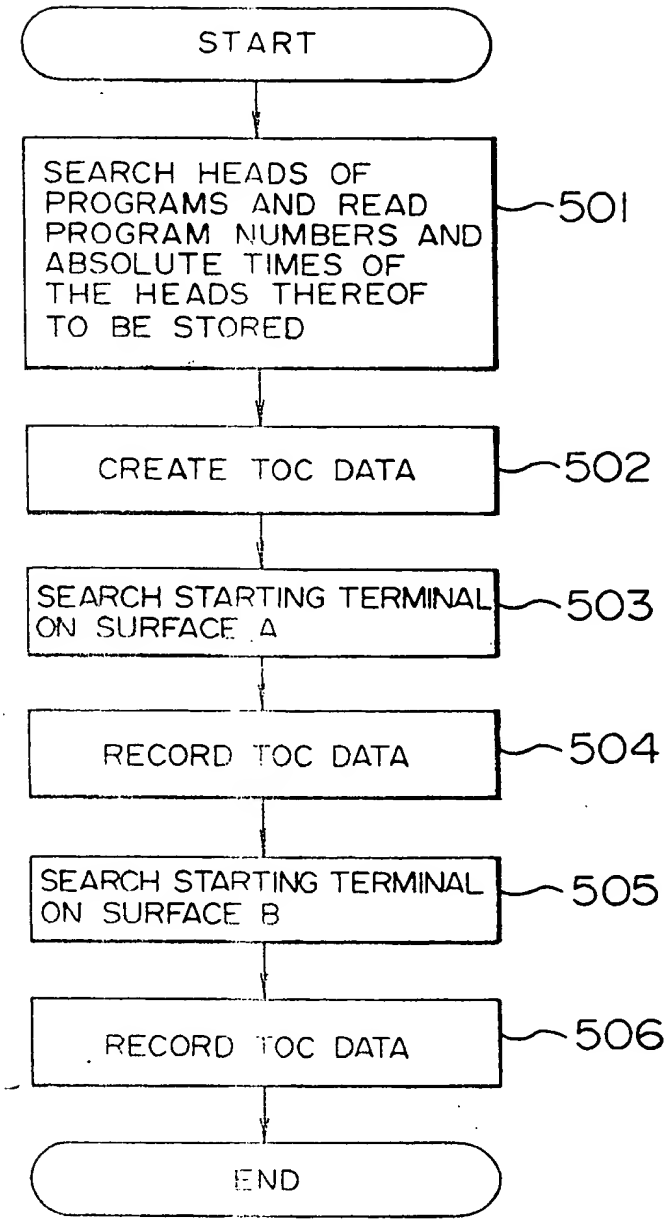

START
SEARCH HEADS OF PROGRAMS AND READ PROGRAM NUMBERS AND ABSOLUTE TIMES OF THE HEADS THEREOF TO BE STORED
501
CREATE TOC DATA
502
SEARCH STARTING TERMINAL ON SURFACE A
503
RECORD TOC DATA
504
SEARCH STARTING TERMINAL ON SURFACE B
505
RECORD TOC DATA
506
END

FIG. 6

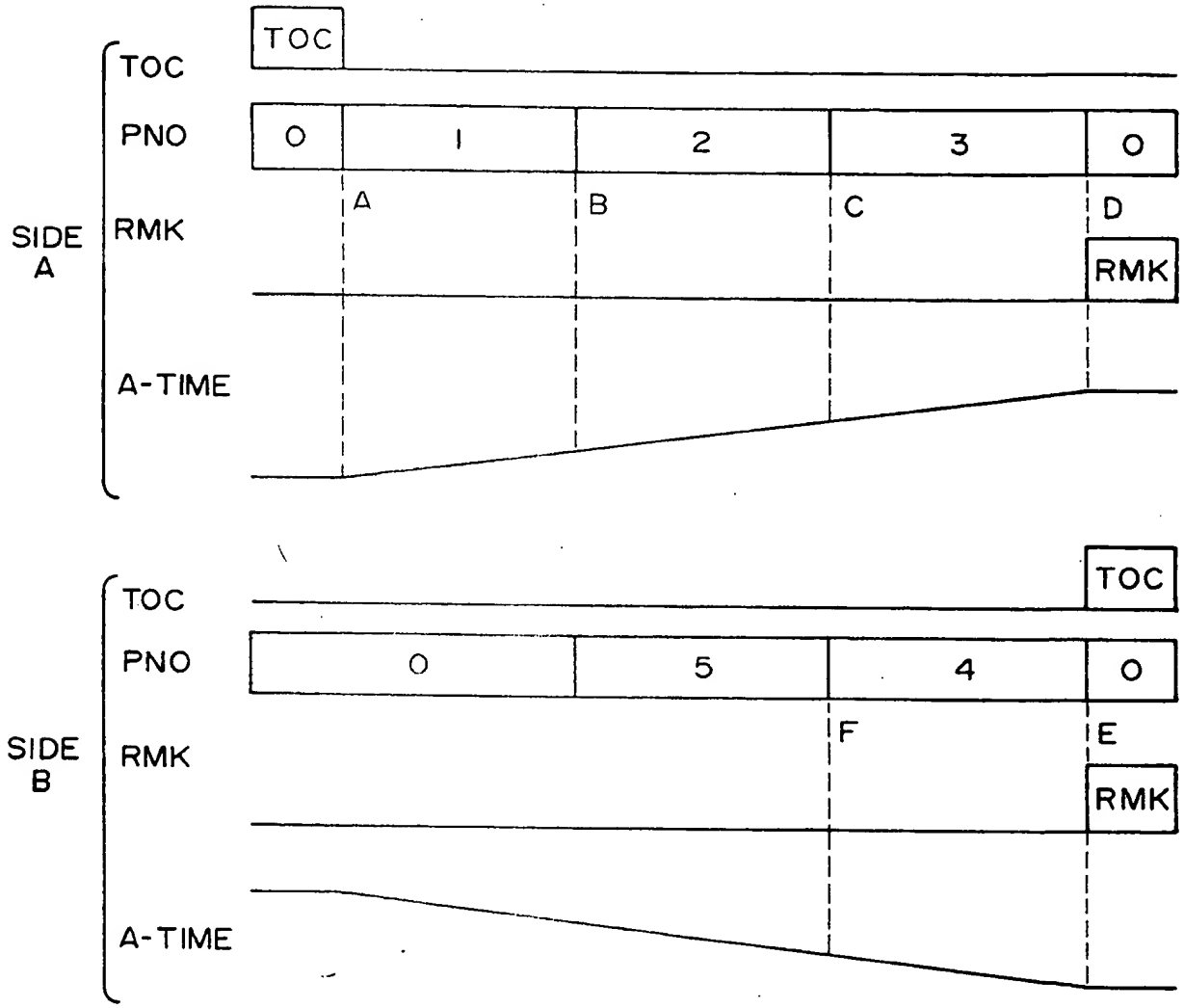

TOC
SIDE A
TOC
PNO
0
1
2
3
0
A
B
C
D
RMK
RMK
A-TIME
TOC
SIDE B
TOC
PNO
0
5
4
0
F
E
RMK
RMK
A-TIME

FIG. 7

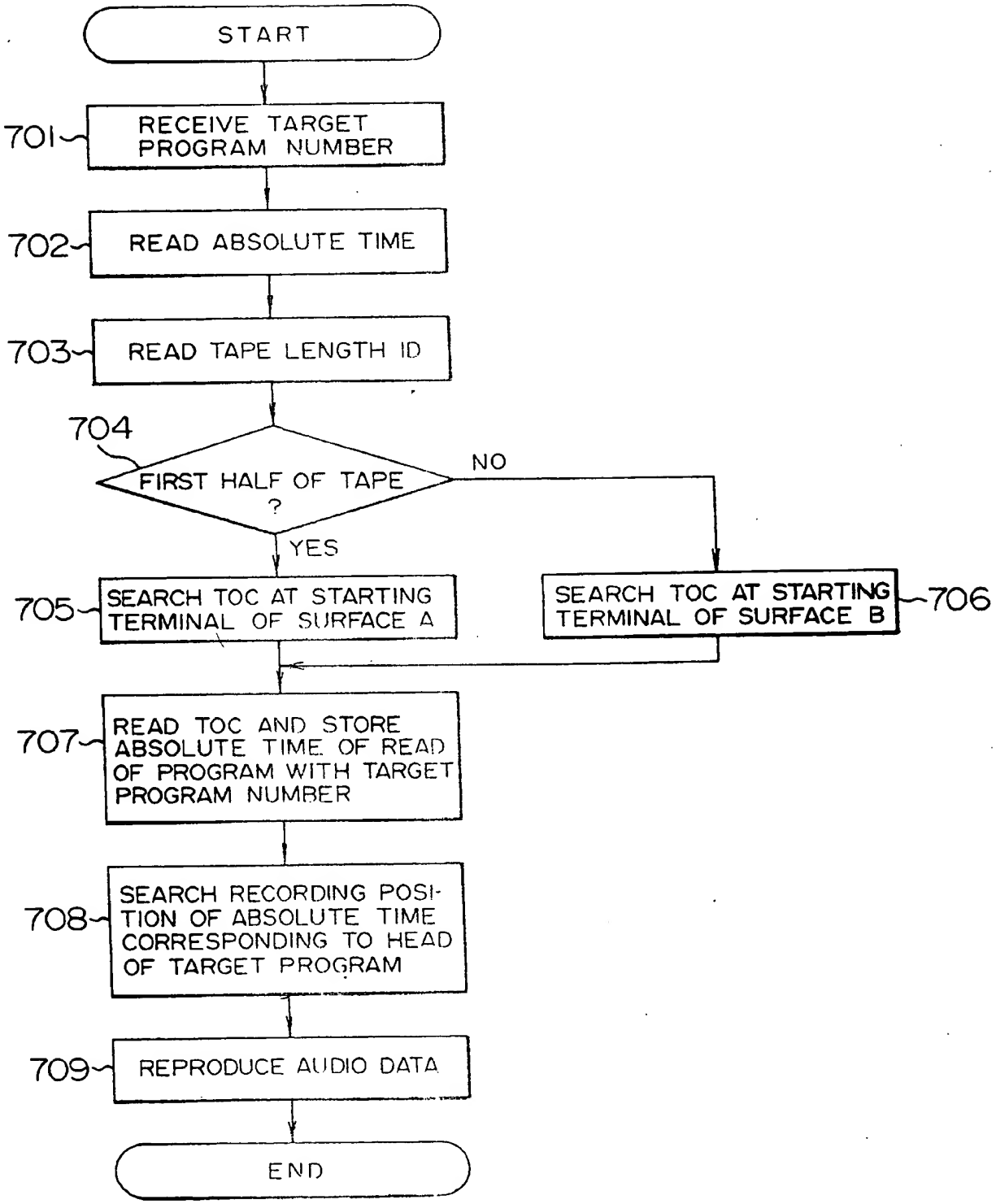

START
701
RECEIVE TARGET PROGRAM NUMBER
702
READ ABSOLUTE TIME
703
READ TAPE LENGTH ID
704
FIRST HALF OF TAPE ?
NO
YES
705
SEARCH TOC AT STARTING TERMINAL OF SURFACE A
SEARCH TOC AT STARTING TERMINAL OF SURFACE B
706
707
READ TOC AND STORE ABSOLUTE TIME OF READ OF PROGRAM WITH TARGET PROGRAM NUMBER
708
SEARCH RECORDING POSITION OF ABSOLUTE TIME CORRESPONDING TO HEAD OF TARGET PROGRAM
709
REPRODUCE AUDIO DATA
END

FIG. 8

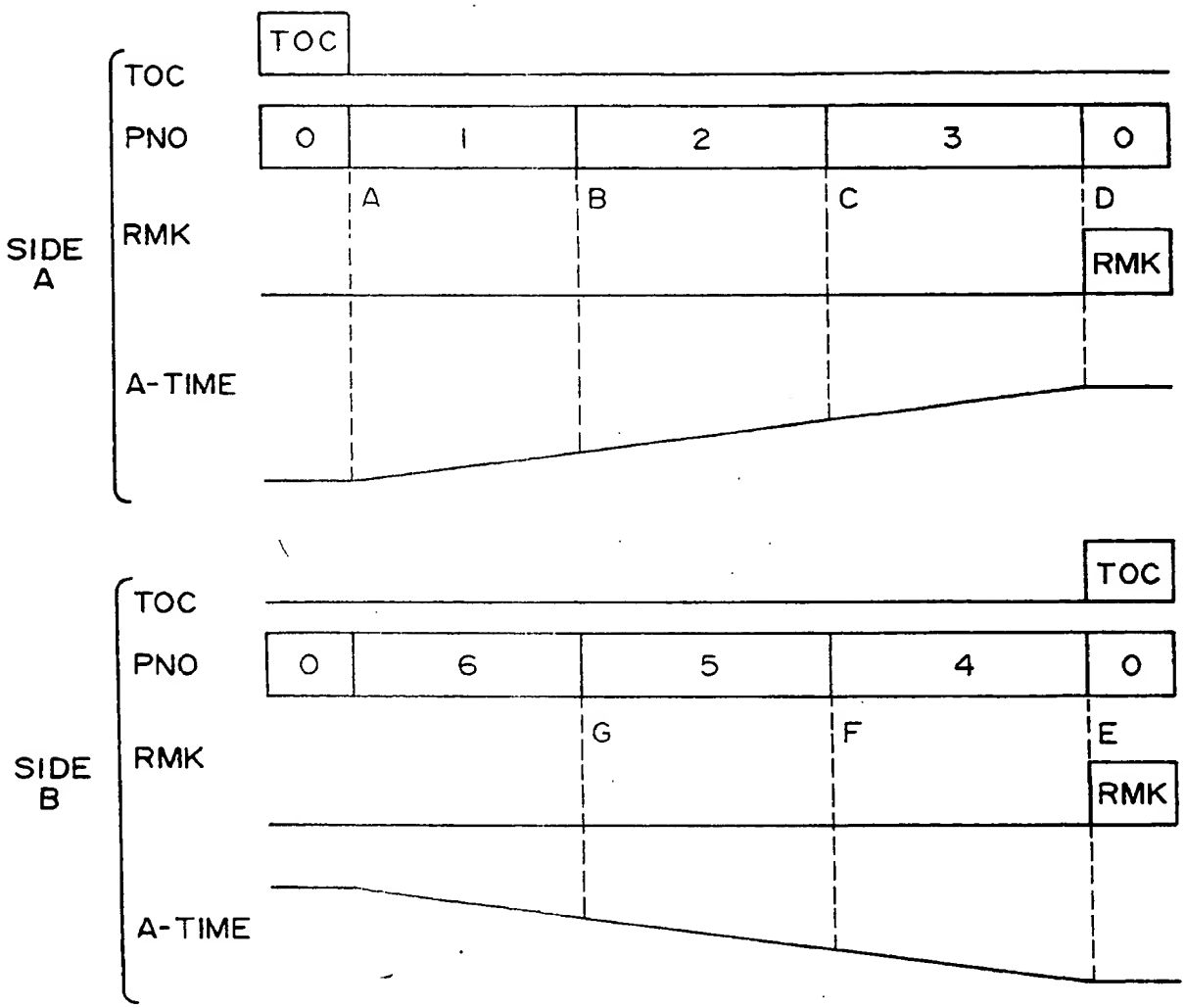

TOC
TOC
PNO
0
1
2
3
0
A
B
C
D
SIDE A
RMK
RMK
A-TIME
TOC
TOC
PNO
0
6
5
4
0
G
F
E
SIDE B
RMK
RMK
A-TIME

FIG. 9

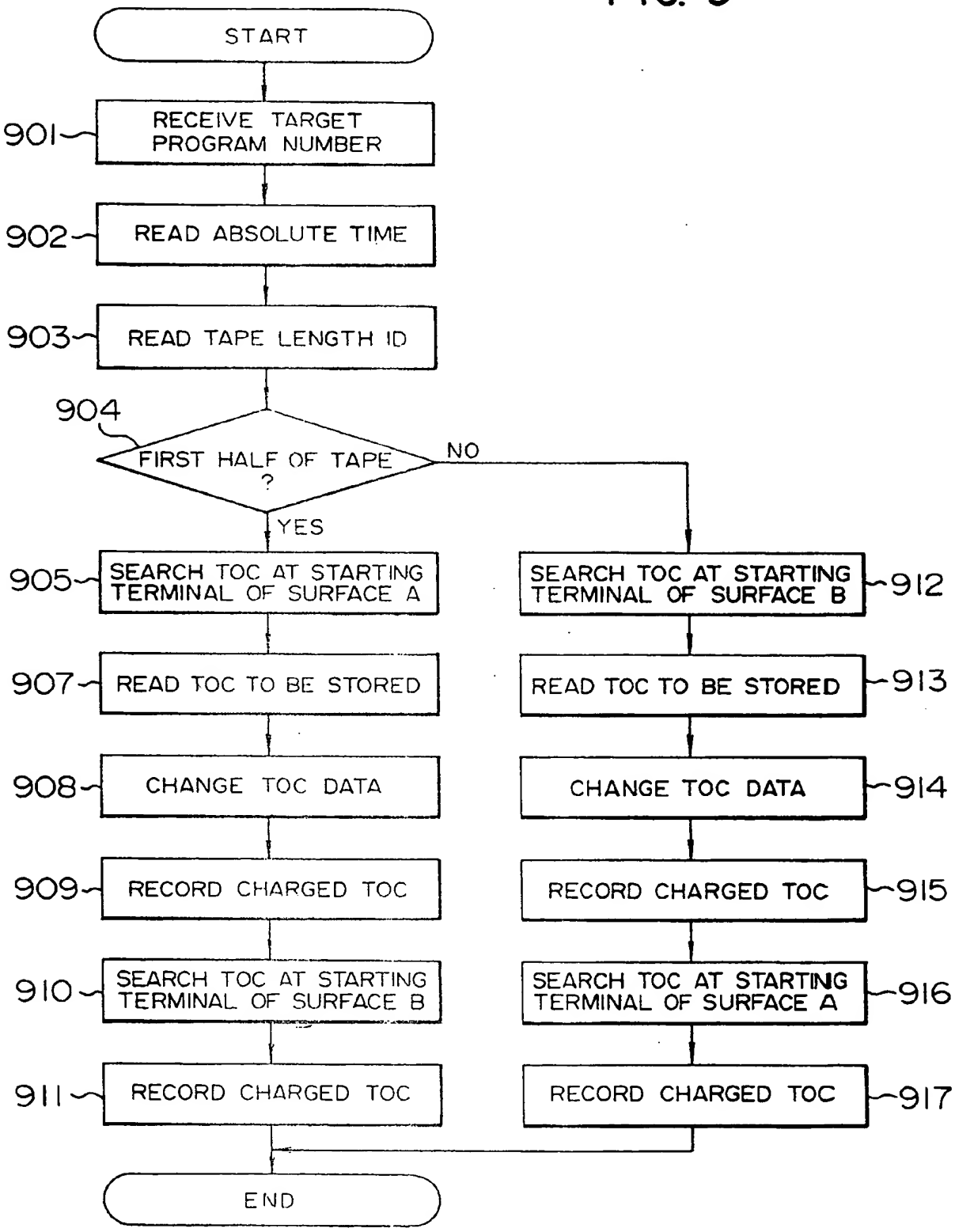
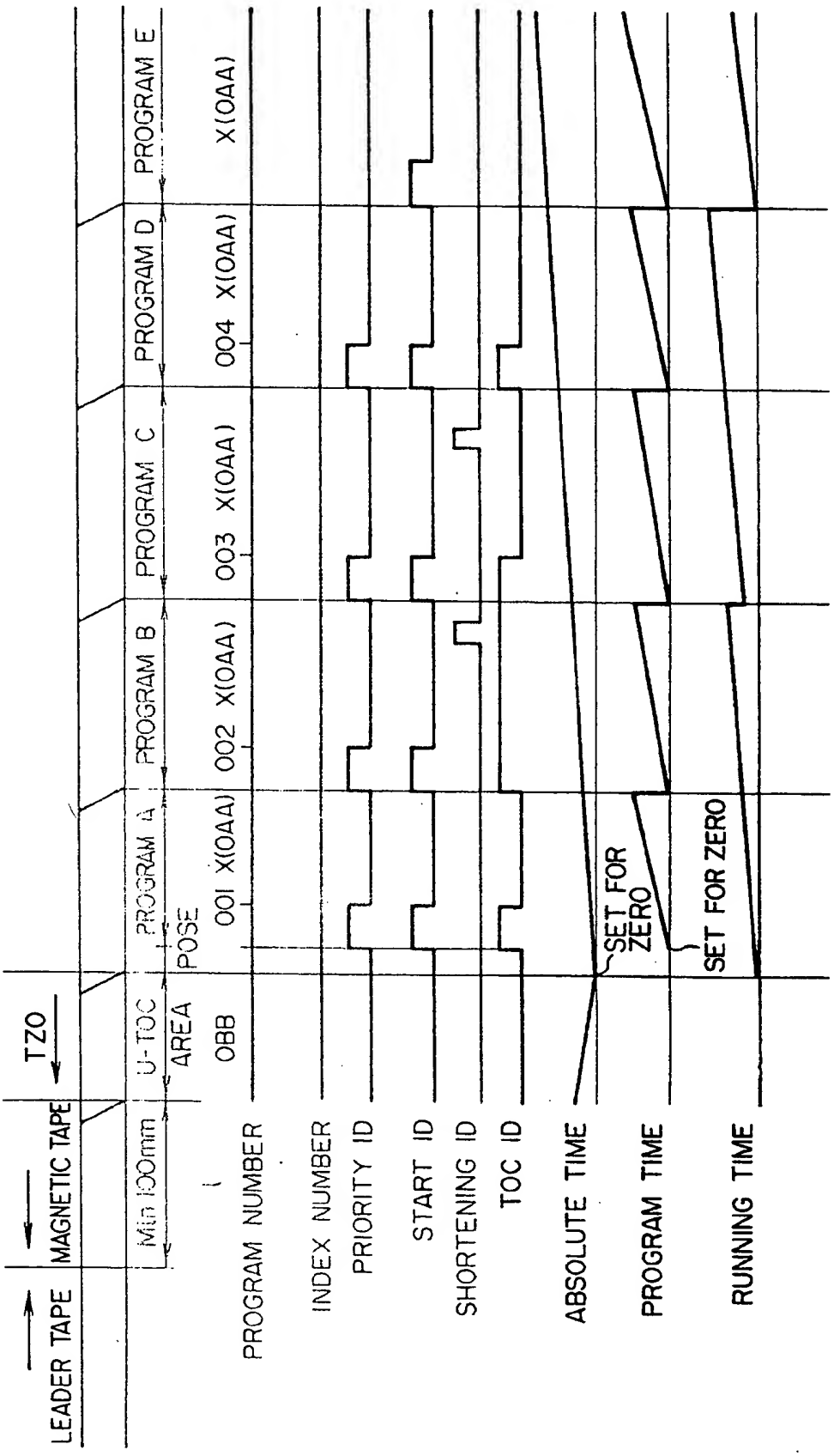

START
901
RECEIVE TARGET PROGRAM NUMBER
902
READ ABSOLUTE TIME
903
READ TAPE LENGTH ID
904
FIRST HALF OF TAPE ?
NO
YES
905
SEARCH TOC AT STARTING TERMINAL OF SURFACE A
907
READ TOC TO BE STORED
908
CHANGE TOC DATA
909
RECORD CHARGED TOC
910
SEARCH TOC AT STARTING TERMINAL OF SURFACE B
911
RECORD CHARGED TOC
912
SEARCH TOC AT STARTING TERMINAL OF SURFACE B
913
READ TOC TO BE STORED
914
CHANGE TOC DATA
915
RECORD CHARGED TOC
916
SEARCH TOC AT STARTING TERMINAL OF SURFACE A
917
RECORD CHARGED TOC
END

FIG. 10


LEADER TAPE
MAGNETIC TAPE
TZO
Min 100mm
U-TOC AREA
PROGRAM A
PROGRAM B
PROGRAM C
PROGRAM D
PROGRAM E
POSE
OBB
001 X(0AA)
002 X(0AA)
003 X(0AA)
004 X(0AA)
X(0AA)
PROGRAM NUMBER
INDEX NUMBER
PRIORITY ID
START ID
SHORTENING ID
TOC ID
ABSOLUTE TIME
PROGRAM TIME
RUNNING TIME
SET FOR ZERO
SET FOR ZERO